WE CLAIM

1. A method of removing photoresist from a substrate, comprising:

treating the photoresist with a first reactant to cause swelling, cracking or delamination of the photoresist;

treating the photoresist with a second reactant to chemically alter the photoresist; and

subsequently removing the chemically altered photoresist with a third reactant.

2. The method of claim 1, wherein the photoresist is formed by ion implantation.

3. The method of claim 2, wherein the ion implantation was performed at a dose of 3×10^{15} ions/cm^2 or higher.

4. The method of claim 1, wherein the first reactant is supercritical carbon dioxide ($SCCO_2$).

5. The method of claim 4, wherein the supercritical carbon dioxide ($SCCO_2$) is at a temperature of 100-150°C and a pressure of 150-200 bar.

6. The method of claim 1, wherein the second reactant is an ozone-based reactant.

7. The method of claim 6, wherein the ozone-based reactant is ozone vapor.

8. The method of claim 6, wherein the ozone-based reactant is ozone gas mixed with water vapor.

9. The method of claim 7, wherein the ozone vapor is at a temperature of 105-115°C and a pressure of 60-80 kPa.

10. The method of claim 7, wherein the ozone vapor is at a concentration of 90,000 ppm or greater.

11. The method of claim 1, wherein the chemically altered photoresist is removed by rinsing.

12. The method of claim 1, wherein the third reactant is deionized water.

13. The method of claim 1, wherein the photoresist is normal photoresist.

14. The method of claim 1, wherein the photoresist is a photoresist damaged by etching.

15. The method of claim 1, wherein the photoresist includes at least one of organic residue and organic contaminants.

16. A method of removing photoresist, from a substrate, comprising:

treating the photoresist with supercritical carbon dioxide ($SCCO_2$);

treating the photoresist with an ozone-based reactant; and

removing the photoresist with deionized water.

17. The method of claim 16, wherein the supercritical carbon dioxide ($SCCO_2$) is at a temperature of 100-150°C and a pressure of 150-200 bar.

18. The method of claim 16, wherein the ozone-based reactant is ozone vapor at a temperature of 105-115°C and a pressure of 60-80 kPa.

19. A method of removing photoresist from a substrate, comprising:

loading the substrate into a chamber;

injecting a first reactant into the chamber and converting the first reactant to supercritical condition;

maintaining contact between the substrate and the supercritical first reactant;

depressurizing the chamber;

injecting a second reactant into the chamber;

maintaining contact between the substrate and the second reactant;

purging the chamber and unloading the substrate;

removing the photoresist; and

drying the substrate.

20. The method of claim 19, further comprising:

before injecting the second reactant, loading the substrate into a second chamber, wherein said maintaining and purging occur in the second chamber.

21. The method of claim 19, wherein the first reactant is supercritical carbon dioxide ($SCCO_2$).

22. The method of claim 21, wherein the supercritical carbon dioxide ($SCCO_2$) is at a temperature of 100-150°C and a pressure of 150-200 bar.

23. The method of claim 19, wherein the second reactant is an ozone-based reactant.

24. The method of claim 23, wherein the ozone-based reactant is ozone vapor.

25. The method of claim 23, wherein there is a 10-15° difference between the second chamber and the ozone-based reactant.

26. The method of claim 25, wherein the second chamber is at a temperature of 105°C and the ozone-based reactant is at a temperature of 115°C and a pressure of 60-80 kPa.

27. The method of claim 23, wherein the ozone-based reactant is at a concentration of 90,000 ppm.

28. The method of claim 19, wherein the rinse is a deionized water rinse.

29. The method of claim 21, wherein the supercritical carbon dioxide ($SCCO_2$) causes swelling, cracking or delamination of the photoresist.

30. The method of claim 24, wherein the ozone vapor alters the photoresist into a water soluble product.

31. An apparatus for removing photoresist from a substrate, comprising:

at least one chamber for treating the photoresist with a first reactant to cause swelling, cracking or delamination of the photoresist, for treating the photoresist with a second reactant to chemically alter the photoresist, for rinsing the substrate, for drying the substrate and for holding the substrate; and

transfer means for transferring the substrate between chambers.

32. The apparatus of claim 31, said apparatus including a single chamber for treating the photoresist with the first reactant to cause swelling, cracking or delamination of the photoresist, and for treating the photoresist with the second reactant to chemically alter the photoresist.

33. The apparatus of claim 31, said apparatus including a separate chamber for treating the photoresist with the first reactant to cause swelling, cracking or delamination of the photoresist, and for treating the photoresist with the second reactant to chemically alter the photoresist.

34. The apparatus of claim 31, said apparatus including a separate chamber for each operation.

35. The apparatus of claim 31, said transfer means including a robotic arm.

36. The apparatus of claim 31, wherein the photoresist is formed by ion implantation.

37. The apparatus of claim 36, wherein the ion implantation was performed at a dose of 3 x 10^{15} ions/cm^2 or higher.

38. The apparatus of claim 31, wherein the first reactant is supercritical carbon dioxide ($SCCO_2$).

39. The apparatus of claim 38, wherein the supercritical carbon dioxide ($SCCO_2$) is at a temperature of 100-150°C and a pressure of 150-200 bar.

40. The apparatus of claim 31, wherein the second reactant is an ozone-based reactant.

41. The apparatus of claim 40, wherein the ozone-based reactant is ozone vapor.

42. The apparatus of claim 41, wherein the ozone vapor is at a temperature of 105-115°C and a pressure of 60-80 kPa.

43. The apparatus of claim 41, wherein the concentration of the ozone in an ozone generator is 90,000 ppm or greater.

44. The apparatus of claim 31, wherein the rinse is a deionized water rinse.

45. The apparatus of claim 31, wherein the first reactant is supercritical carbon dioxide ($SCCO_2$) and the second reactant is ozone, said single chamber including a

heater jacket, a carbon dioxide (CO_2) source, a supercritical carbon dioxide ($SCCO_2$) generator, a supercritical carbon dioxide ($SCCO_2$) circulator, a carbon dioxide (CO_2) feedback, an ozone gas generator, a vapor generator, and an exhaust.

46. The apparatus of claim 45, wherein the supercritical carbon dioxide ($SCCO_2$) generator includes a carbon dioxide (CO_2) pressure pump and a carbon dioxide (CO_2) heater.

47. The apparatus of claim 31, wherein the first reactant is supercritical carbon dioxide ($SCCO_2$) and a first of the separate chambers includes a heater jacket, a carbon dioxide (CO_2) source, a supercritical carbon dioxide ($SCCO_2$) generator, a supercritical carbon dioxide ($SCCO_2$) circulator, and a carbon dioxide (CO_2) feedback.

48. The apparatus of claim 47, wherein the supercritical carbon dioxide ($SCCO_2$) generator includes a carbon dioxide (CO_2) pressure pump and a carbon dioxide (CO_2) heater.

49. The apparatus of claim 47, wherein the second reactant is an ozone-based reactant, and a first of the separate chambers includes a heater jacket, an ozone gas generator, a vapor generator, and an exhaust.

50. The apparatus of claim 49, wherein the ozone-based reactant is ozone vapor.